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CURRENT REMEDIAL ACTION PROGRAM IN SUPPORT OF SUPERFUND

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16. ABSTRACT

The Land Pollution Control Division (LPCD); Hazardous Waste Engineering Research Laboratory (HWERL) has the responsibility for the control development program in support of "Superfund." The LPCD research and development program has been organized to correspond with the "Superfund" legislation, i.e., the Releases Control Branch deals with removal actions (emergencies), and the Containment Branch deals with remedial actions. The program is one of technology development and assessment to determine cost and effectiveness, adaptation of technologies to the uncontrolled waste site problem, field evaluation of technologies that show promise, development of guidance material for the EPA Office of Emergency and Remedial Response (OERR), technical assistance to OERR, and EPA Regional Offices.

The remedial action program is divided into four major areas of activity: (1) Survey and Assessment of Current Technologies, (2) Laboratory and Site Design Analysis, (3) Field Evaluation and Verification of Techniques and (4) Technical Handbooks. An overview of the removal and remedial program is presented.

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INTRODUCTION

Within the EPA Office of Research and Development, the Land Pollution Control Division (LPCD), Hazardous Waste Engineering Research Laboratory (HWERL) has the responsibility for the control development program in support of "Superfund." The LPCD research and development program has been organized to correspond with the "Superfund" legislation, i.e., the Releases Control Branch deals with removal actions (emergencies), and the Containment Branch deals with remedial actions. Due to the special demands of "Superfund," the normal research and development process of concept development, laboratory evaluation, pilot testing, and field demonstration cannot always be followed. "Superfund" is a 5-year program requiring answers today. Thus, our program concentrates on technology assessment to determine cost and effectiveness, adaptation of technologies to the uncontrolled waste site problem, field evaluation of technologies that show promise, development of guidance material for the EPA Office of Emergency and Remedial Response (OERR), technical assistance to OERR, and EPA Regional Offices. Since this paper is primarily addressed towards the remedial action portion of the LPCD Superfund program, only a brief overview will be presented on the removal action portion.

Removal (Emergency) Action

This program has been divided into three major areas of activity: (1) Personnel Health and Safety, (2) Evaluation of Equipment, and (3) Chemical Countermeasures. The goal of the personnel health and safety activity is to develop protective equipment and procedures for personnel working on land or underwater in environments which are known or suspected to be immediately dangerous to life or health, so that personnel can conduct operations related to investigating, monitoring, or cleaning up hazardous substances.

The goal of the equipment evaluation activity is to modify, adapt and field test hazardous substances spill control equipment for appropriate utilization for removal action at uncontrolled dump sites. Examples of this equipment are the mobile incinerator, modular transportable incinerator, carbon regenerator and soils washer.

The goal of the chemical countermeasures activity is to evaluate the efficiency of in-situ physical/chemical/biological treatment of large volumes of subsurface soils and large relatively quiescent waterbodies for the purpose of controlling the hazardous contaminants within those media. Technical criteria for the use of chemicals and other additives to control hazardous release situations are being developed.

Remedial Action

This program is designed to assist the Office of Emergency and Remedial Response, Regional Offices, states, and industry to meet the challenge of protecting the public from the environmental effects of uncontrolled hazardous waste sites. The major emphasis of the program is to take "off-the-shelf" technology and adapt it to the uncontrolled hazardous waste site situation. Many existing technologies, such as those used in the construction industry, wastewater treatment, and spill cleanup, can be applied to uncontrolled waste sites. However, their application must be tested, cost and effectiveness determined, and limitations understood so that they may be effectively and economically utilized. It is a major function of this program to evaluate these techniques and combine them into cost-effective remedial actions for the various situations found at uncontrolled waste sites.

This program has been divided into four areas of activity: (1) Survey and Assessment of Current Technologies, (2) Laboratory and Site Design Analysis, (3) Field Evaluation and Verification of Techniques and (4) Technical Handbooks.

Survey and Assessment of Current Technologies

The goal of this activity is to review and evaluate the effectiveness of remedial action long term control techniques that are being used and have been used to contain pollutants at uncontrolled hazardous waste sites. Analyses includes defining the site specific problem, determining the problems associated with implementing the techniques, determining the effectiveness, and identifying costs. This activity also includes the development and use of models.

A completed effort (1)* presents a survey of ongoing and completed remedial action projects. Ten case study sites were selected and these sites were visited and inspected for remedial action information. The results of this completed effort were published in a final report entitled "Survey of On-Going and Completed Remedial Action Projects" (EPA-600/2-81-246) September 1981. This survey has been updated in a report entitled "Survey and Assessment of Completed and Ongoing Remedial Action Efforts" (EPA 540/2-84-002) dated February 1984. New survey studies will continue to be conducted.

*Parentheses numbers refer to the project officer who is monitoring this effort and whose name is listed immediately following their paper. The project officer can be contacted for additional information.

The cost and economic aspects of the survey and assessment activity focus on remedial action cost estimation, cost-effectiveness procedures, and economic issue evaluations related to CERCLA. The emphasis on remedial action issues generally reflects the crucial concern that the selected remedial action alternative be the most cost-effective as mandated by CERCLA.

One effort (2) analyzed unit operations cost data for long term remedial action programs at uncontrolled hazardous waste sites. The analysis included an outline of the process for costing remedial action unit operations and combining the unit operations to yield relative cost data for an entire remedial action scenario. The final report entitled "Costs of Remedial Response Actions at Uncontrolled Hazardous Waste Sites" (EPA 600/2-82-035) dated March 1983 is available. A continuation effort is evaluating the effects of human safety and degree-of-hazard considerations on remedial action costs. This information will be used to adjust total remedial action unit operation costs. The draft final report entitled "Costs of Remedial Actions at Uncontrolled Hazardous Waste Sites: Worker Health and Safety Considerations" will be available in early 1985.

Cost information for the above studies along with actual expenditure data from case studies is included in a cost compendium that will be periodically updated and is currently being computerized. The first "Cost Compendium for Remedial Action Technologies" is expected to be published in early 1985.

The principal objective of another completed cost study (2) was to develop an analytical framework for conducting cost-effectiveness and reliability evaluations of remedial options at uncontrolled hazardous waste sites. CERCLA requires that remedial actions to be implemented under Superfund must be cost-effective. This is defined in the National Contingency Plan as "the lowest cost alternative that is technologically feasible and reliable and which effectively mitigates and minimizes damage to and provide adequate protection of public health, welfare, or the environment." A methodology for making determinations of cost-effectiveness has been developed and a guidance document describing the application of the framework will be prepared, which can be used by EPA and state regulatory personnel to aid in consistent and comprehensive evaluation of the factors affecting reliability and cost-effectiveness of remedial actions. A draft report entitled "Guidance for Conducting Feasibility Studies under CERCLA" has been prepared and reviewed and will be published in early 1985.

The four volume final draft document (2) entitled "Remedial Action Technology Evaluation Modeling" has been completed by Anderson-Nichols and Company. The four volumes represent a cooperative effort among the Hazardous Waste Engineering Research Laboratory, the Athens Environmental Research Laboratory, and the Office of Environmental Processes and Effects Research. The objective of this document is to provide technical guidance on the selection and application of models for evaluating remedial action alternatives at uncontrolled hazardous waste sites. The volumes cover selection of models, simplified methods for subsurface and waste control actions, numerical modeling of surface, subsurface and waste control actions, and analytical and numerical models for evaluation of surface water remedial actions. The report is currently undergoing external peer review and is anticipated to be published in February 1985.

Laboratory and Site Design Analysis

The goal of this activity is to perform laboratory studies to simulate field conditions and evaluate the adequacy of adapting the lab control technology schemes to actual field conditions.

One completed effort (3) was a study conducted to determine the known information on the compatibility of grouts with different classes of chemicals. The information in this study

can be used as a basis for testing and selecting grouts to be used at specific waste disposal sites with various leachates and has been published in a report entitled "Compatibility of Grouts with Hazardous Wastes" (EPA 600/2-84-015) dated January 1984.

In a separate laboratory investigation (4) the compatibility of various chemicals with several grouts is being tested to determine any adverse effect with setting and durability. Promising grouts will be evaluated in field tests. This project is scheduled for completion in December 1985.

Another ongoing effort (5) concerns evaluating the uses of geotextiles in stabilizing cover soils on landfills, acting as drainage layers for gases and liquids, and acting as bedding for membrane barriers. This program studied available geotextiles and geotextile products, their engineering properties, sizes available (length, width, thickness), chemical resistance, seaming techniques, relative cost, life expectancy, and specific potential usage. This project included an initial assessment of problems at a municipal refuse landfill site in Windham, Connecticut, and recommendations for those remedial measures in which

geotextiles could play a significant role. The final report entitled "Evaluation of the Use of Geotextiles for Landfill Cover Systems" will be published in April 1985.

Another completed effort (6) has developed methods for classification of wastes by chemical and/or reactive properties and lays out a logical sequence of activities to determine the compatibility of two wastes. The test scheme includes 1. field test kit, 2. manual containing flow diagrams and test procedure, and 3. mixing device. Simple and rapid field tests to determine reactive properties, chemical class, generic name and results of mixing are described. The testing protocol was challenged with 60 compounds and mixtures in the laboratory and field tested using 29 waste samples. Laboratory observation of 755 samples resulted in 15 false positives and 2 false negatives. The report entitled "Design and Development of a Hazardous Waste Reactivity Testing Protocol" (EPA 600/S2-84-057) dated April 1984 has been published.

Another ongoing effort (7) is a three-phase activity which will develop criteria for evaluating the use of permeable materials as hazardous waste pollutant control mechanisms. The utility of such permeable treatment barriers as coal, fly ash, limestone, and other material will be addressed. A final report is anticipated in late 1985.

Another ongoing effort (8) is investigating the use of asphalt encapsulating techniques as a treatment containment option for hazardous waste. Mixing heated asphalt with a sludge material to coat or microencapsulate the sludge particles could improve leachate quality and could act to reduce the hazardous nature of some compounds in the sludge. A final report is anticipated in December 1985.

An ongoing effort (9) is investigating the effectiveness of generic processes for stabilizing soils to prevent the release of pollutants. Dioxin contaminated soils from EPA Region VII, Missouri Dioxin sites, will be investigated first. Soils will be stabilized and leached to determine the effectiveness of the stabilization techniques utilized. A follow on field evaluation is planned. The laboratory effort for this study is due for completion in February 1985.

Field Evaluation and Verification of Techniques

The goal of this activity is to field test control technology techniques that look very promising and/or test the technique being installed to determine performance with time and to validate promising control techniques being developed by lab and pilot studies.

An ongoing effort (9) involved the installation of a surface cap at a Connecticut municipal solid waste site. Results to date are available in an interim report entitled "Remediation of an Inoperative Municipal Waste Landfill - Windham Landfill, Windham, Connecticut." Studies will continue to determine the effectiveness of the cap over the next several years.

Another completed effort (10) is the demonstration of a block displacement technique to seal off large blocks of contaminated earth. This technique is designed to place a low-permeability material across the bottom and around the sides of the block of contaminated earth using drilling and fracturing techniques which displace the block through injection of a specially formulated bentonite slurry. This project provides data which demonstrates the feasibility of this technique at a reasonable subsurface depth in a region of favorable geology. Problems associated with unknown geologic materials and the interrelationship with slurry injection technology were identified, serving as a significant data base upon which further practice can be more accurately predetermined. The field construction within this project has been completed and the report entitled "The Block Displacement Method Field Demonstration and Specifications" will be available in early 1985.

An ongoing effort (1) is concerned with the effectiveness of a slurry wall used as a remedial action at a hazardous waste site. This effort will be completed in three phases: Phase one will review and interpret the quality control data that was obtained during the construction of the slurry wall. An example, is the data obtained from hydrologic conductivity tests run on the trench backfill material. Phase two is concerned with the integrity of the completed wall. Not only is it concerned with seepage of contaminants directly through the wall backfill itself, but additional leakage through anomalies in the wall. Several detection methods will be investigated to determine their value in locating the size and frequency of anomalies in the wall. Phase three will obtain direct evidence of wall performance including evaluation of seepage quantities and contaminant migration. The final report is not expected until mid 1986.

Another ongoing effort (11) is an investigation of the failure mechanisms and migration of industrial chemicals at a hazardous waste disposal site. The site has been closed and is under court order to be excavated for reburial elsewhere. During excavation of the landfill, the soil, facility, and waste conditions will be observed and samples are being collected. In the limited tests to date, field-measured hydraulic conductivity for several geologic units has been

significantly greater than laboratory measured hydraulic conductivity using recompacted samples when the facility was designed. Pollutant migration appears to be concentrated in these units. Work is also underway on correlation of piping susceptibility (by the pin hole test) with observations of sink-holes and subsidence in trench covers. The final report of this task is expected to be published in June 1985.

Another ongoing effort (12) is concerned with determining the feasibility of retrofitting existing surface impoundments with an effective membrane liner system. This study evaluates one or more technically feasible retrofit liner installation techniques including the applicable liner candidate materials. The work assesses under which physical and chemical in situ conditions the various techniques will have the greatest chance for success. External equipment requirements, safety, and economics as well as overall limitation are being determined. Pilot-scale and field verification will follow the technical and economical assessment with the published report expected in January 1985. The data and procedures developed in this project will be used to update the existing TRD reports entitled "Lining of Waste Impoundment and Disposal Facilities" (SW-870) and "Closure of Hazardous Waste Surface Impoundments" (SW-873) available from the U. S. Government Printing Office (055-000-0231-2 and 055-000-00227-4).

An ongoing effort (13) is evaluating a prototype full-scale process for encapsulating corroding 55-gallon drums of hazardous waste. This overpack system utilizes friction-welding (spin-welding) to fuse a polythylene (PE) cover onto a PE receiver into which a 55-gallon of waste has been inserted. The overpack is designed for easy stacking and can be handled with conventional drum handling equipment. This report will be available in early 1985.

An ongoing effort (5) is investigating the impact of utilizing in-situ freezing techniques to control the level of contaminants migrating from uncontrolled hazardous waste sites.

The purpose of this project is to investigate the effects that ground freezing has on hazardous waste site contaminants. Specific areas of focus include the transport of pollutants in soils subjected to freezing, the impact of soil freezing on the level of pollutants in the leachate, and the feasibility of using ground freezing technology at hazardous waste sites. The project is composed of two phases; phase one is a review of the literature, and phase two consists of laboratory-scale experiments.

Phase one has been completed. Topics investigated included the beneficial and detrimental effects of naturally occurring freezing and thawing cycles, the beneficial and detrimental

aspects of artificial freezing, the chemistry of soil freezing, effects of freezing on soil physical properties, the fate of contaminants in relation to the direction of the freezing front, purification of contaminated material by freezing, soil freezing technology, the feasibility of employing freeze walls (frozen soil) as barriers to pollutant migration, and the economics of artificial ground freezing.

Phase two, laboratory-scale experimentation, is now being conducted. Plexiglas columns 5 inches in diameter and 32 inches in height have been filled with contaminated material and are being subjected to controlled freezing and thawing. Specific objectives are to study the transport of contaminants in soils subjected to a constant rate of freezing, to study the impact of soil freezing on the level of contaminants in the leachate, and to study the movement of selected contaminants during controlled freezing/thawing cycles. Contaminants being studied include both organics and metals. A final report is anticipated in late 1985.

Technical Handbooks

The goal of this activity is to prepare technical handbooks incorporating best engineering remedial action control technologies to contain pollutants eminating from uncontrolled

hazardous waste sites. These technical handbooks will be utilized by the planners and designers of remedial actions. Below is a listing of the technical handbooks that have been prepared or are being prepared.

A handbook entitled "Remedial Action Technology for Waste Disposal Sites" was published as EPA 625/2-82-006 in June 1982 as an initial summary of technologies which may be utilized at remedial action sites (9).

A more recent effort (3) describing evaluation process for use in deciding which remedial action techniques is best suited for which specific situation has been published in a report entitled "Handbook for Evaluating Remedial Action Technology Plans" EPA 600/2-83-076 dated August 1983.

An ongoing effort (5) is concerned with the development of a handbook which can be used as a guidance document for the selection, design, installation, and long-term maintenance of covers as remedial actions. This handbook entitled "Technical Handbook for Design and Construction of Covers for Uncontrolled Hazardous Waste Sites" will provide technical information for regulatory personnel as well as guidance for cover-system designers and construction engineers, and will be available in early 1985.

A completed effort (10) produced a handbook for slurry trench cutoff wall design, construction, and performance evaluation. This handbook is entitled "Slurry Trench Construction for Pollution Migration Control" (EPA 540/2-84-001) dated February 1984.

Another ongoing effort (5) is the development of a handbook to provide guidance for the evaluation, selection, and use of solidification/stabilization technology as a remedial action alternative at uncontrolled hazardous waste sites. The planning for the application of solidification/ stabilization is divided into two phases: process selection and scenario selection. Process selection is concerned with the chemistry of the solidification/stabilization processes is the identification of the composition of the waste. Presented in the handbook are testing and analysis techniques for characterizing waste as a basis for selection of pretreatment and stabilization/solidification processes. Also data are developed on the compatibility of additives and specific classes of waste, and testing systems for the evaluation of stabilized/solidified wastes are reviewed. Scenario selection is concerned with the development of equipment requirements, construction sequencing, and cost estimating for the chosen solidification/stabilization process. The handbook will present, based on field surveys, four basic field scenarios

that have been used successfully. A draft final report entitled "Technical Handbook for Stabilization/Solidification Alternatives for Remedial Action at Uncontrolled Hazardous Waste Sites" has been prepared with anticipated publication in mid 1985.

An ongoing effort (6) is currently underway to develop a decontamination manual for EPA Headquarters program offices and regional Superfund programs as part of the restoration profile of Superfund sites. The manual will give guidelines on 1. the extent to which contamination of buildings, structures and construction equipment can be reduced or eliminated, 2. decontamination methods, 3. costs, 4. health hazards and 5. availability of equipment/personnel for the detoxification procedures. Specific waste types found in contaminated buildings, structures and equipment at Superfund sites will be identified. Potential secondary impacts from the available and potential decontamination treatment methods will be evaluated in this study. Decontamination costs versus risk and projected ultimate site usage will be determined and evaluated. Methods for monitoring the success of the various procedures will be defined. The project report is scheduled for publication in late 1985.

Another ongoing effort (6) is to assess the feasibility of alternative uses of hazardous waste sites following remedial measures. Phase one is a data collection phase which consists of reviewing current literature, data and technical reports; interviews with experienced personnel in the area of site remediation and reuse, and site visitations where reuse has been implemented. Phase two will focus on identifying areas of site remediation and redevelopment activities that would need to be considered in future site planning/decision making for specific hazardous waste sites. The final report entitled "Feasibility of Site Usage Following Hazardous Remedial Actions" is expected to be published in late 1985.

Another ongoing project (1) is entitled "Control of Fugitive Dust Emissions at Hazardous Waste Sites." Three field studies were performed to determine the effectiveness of dust control technologies at hazardous sites. In the first field study a total of 12 dust suppressants were tested to determine the effectiveness of fugitive dust control against wind erosion from exposed areas. Based on a tracer sampling protocol, the suppressants were 100 percent effective for 1 to 4 weeks after application, with declining control efficiencies thereafter. The second wind erosion field study was an evaluation of the effectiveness of windscreens and windscreen/dust suppressant combinations in controlling fugitive dust from storage piles.

Based on 82 tests, the windwcreen showed no consistent significant level of control of particles less than 10 micrometers. The wind erosion emission rate of particles less than 10 micrometers is fairly constant at windspeeds above a threshold of about 7 mph hourly average. The windscreen may control larger particles more effectively, but these particles are less of a threat because they exceed the inhalable size and are not carried long distances in the wind. Chemical stabilizers were superior in performance to the windscreen. The third field study, investigating active cleanup emissions, consisted of testing fugitive dust control measures applicable to the use of a front-end loader to load dirt into a truck. Control efficiencies of 41 to 77 percent were measured for area spraying and spray curtains. The handbook on fugitive dust control techniques is planned for publication in June 1985.

A report (6) on leachate plume management techniques is undergoing final revisions. This handbook will describe the factors that affect leachate plume movement, key considerations in delineating the current and future extent of the leachate plume technologies for controlling the migration of plumes, and criteria for evaluating and selecting plume management alternatives. The report should be available in early 1985.

CONCLUSIONS

The laboratory and field research project efforts discussed here reflect the LPCD effort in responding to critical need of the Superfund Program, i.e., reliable and cost-effective control technology. The efforts mentioned have developed a sufficient data base to warrant discussion. More information about a specific project or study can be obtained by contacting the project officer referenced in the text. Inquiries can also be directed to the Director, Land Pollution Control Division, Hazardous Waste Engineering Research Laboratory, U. S. Environmental Protection Agency, 26 W. St. Clair Street, Cincinnati, Ohio 45268. Information will be provided with the understanding that it is from research in progress and the conclusions may change as techniques are improved and more complete data become available.

PROJECT OFFICERS

All the Project Officers can be contacted through the Land Pollution Control Division (LPCD) whose phone numbers are listed below and whose address is shown above.

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